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Studies in Sisyrinchium—VI: Additional new Species from the Southern States

BY EUGENE P. BICKNELL

In the South Atlantic and Gulf States the genus *Sisyrinchium* has expressed itself with marked emphasis. Although not hitherto regarded as forming more than a very insignificant feature of the southern flora the group actually embraces such a number of species that it must take rank among the largest homogeneous genera of the south. These numerous species in their general near relation yet perfect distinctness call to mind especially the interesting brotherhood of species in *Eupanicum* among the grasses.

Since the publication of the first paper of this series describing some of these plants, additional material from the South has been received which reveals a further considerable number of species not hitherto suspected to exist. These come to light mainly through the important collection of the Biltmore Herbarium, kindly placed at my disposal by Mr. C. D. Beadle, and through an interesting series of specimens from the South Atlantic States forwarded by Mr. W. W. Ashe.

Including the new species here described the total number now known to me from the region south of Washington, D. C., and east of the Mississippi is thirty-four. I have no reason to doubt the perfect validity of any one of these, but, on the contrary, am well satisfied that certain of them, as *S. Carolinianum* and *S. Atlanticum*, are still aggregates and that the number of species from the Southern States will yet be materially augmented.

[Issued Dec. 22.]

The Texan species will be treated separately in a subsequent paper.

Sisyrinchium incrustatum

Dull green and slightly glaucescent, turning dark when dry, 25–50 cm. high: tufts coarsely brown fibrose at base, the slender roots much elongated. Leaves more than half the height of the stem, 1.5–3.5 mm. wide, erect, tapering to an aculeate point, rather thin but firm and chartaceous, usually harshly rugulose-scabrous between the nerves but varying from merely rugulose to densely incrustate with minute pale points, strongly close-nerved and striate, the striae below becoming prominent and pale in color, often with a lesser alternating series: stems often somewhat curved and twisted, 1.5–3 mm. wide, harsh and scabrous-rugulose like the leaves, especially the prominent wings, the edges like those of the leaves, closely ciliolate-serrulate; nodes one or two, the lower one bearing an erect and prominent often much elongated leaf and two or three peduncles, the upper one terminating an outcurved prolongation of the stem 4–9 cm. long and with a shorter bracteal leaf and mostly three shorter peduncles; peduncles often outcurved, stout or slender, winged, stiff-ciliolate, bracteal leaves harsh and striate like the lower leaves, the clasping base somewhat broadened and oppositely bicarinate: spathes erect or slightly bent, the subequal bracts 15–25 mm. long, stiff and strongly fine-striate, slenderly sharp attenuate to merely acute or the inner one apiculate from a scarious-margined apex, the outer one very narrowly hyaline-margined, smooth or obscurely scabrous-rugulose: scales silvery-brown, acuminate, more than three-quarters the length of the inner bract; flowers 4–9, violet-blue, perianth about 8 mm. long; stamineal column 4–5 mm. high; capsules dark, subglobose, 3–4 mm. high on suberect slightly exserted pedicels; seeds 1–1.25 mm. in diameter, subglobose, finely pitted.

NORTH CAROLINA: in damp or wet sandy soil or in open grassy woods, flowering in July, Forsythe Co., Winston, July, 1897, W. W. Ashe; Sampson Co., W. W. Ashe; Craven Co., July 3, G. McCarthy, U. S. Nat. Herb.

Related to *S. arenicola* and *S. xerophyllum* Greene and apparently in close affinity with *S. rufipes* although a much larger and stouter plant in every way and flowering in midsummer instead of early spring.

Sisyrinchium versicolor

Becoming 35 cm. high, pale green and very glaucous, not drying dark, the sheaths of the leaves rose-pink and the spathes

mostly purplish-tinged; tufts not fibrous at base; roots slender and wiry. Leaves 1.5–3 mm. wide, close-striate, stiff, tapering to an acute point, the edges, like those of the stem mostly serrulate-roughened: stem simple or frequently developing a node with a prominent erect leaf and two peduncles, 1–2.5 mm. wide, the wings distinctly striate: spathes erect, the base narrowed downwards on the sides of the stem, the wings passing up on either side; bracts and lower part of bracteal leaf closely roughened all over with minute points, often prominently striate: outer bract much prolonged beyond the inner in simple stems, little surpassing it when the stem is branched, 2.5–5 cm. long, very acute, the narrowly hyaline margins not united below; inner bract narrow, 17–20 mm. long, often scarious and abruptly pointed at the apex: flowers pale blue, 10–12 mm. long; stamineal column about 5 mm. high: capsules on very delicate, slenderly exserted, subspreading pedicels, pale, apparently subglobose and about 3 mm. high, but not fully mature in the specimens examined.

Washington, D. C., to Georgia, flowering in May.

Washington, D. C., May 11, 1884, U. S. Nat. Herb.

NORTH CAROLINA: Raleigh, May, 1896, hillsides, W. W. Ashe, Type; Chapel Hill, W. W. Ashe.

GEORGIA: A. W. Chapman in Herb. Torr. Bot. Club.

Apparently nearest to *S. intermedium* and *S. mucronatum*, but as compared with both much paler and more glaucous with stiffer more striate leaves and stem and scabrellous bracts. The roughened bracts have much the appearance of those of the twin-spathed *S. scabrellum* or of extreme forms of the more western *S. campestre*. The latter is a lower more slender species, with always simple stems, the inner bract emerging from the outer one more abruptly and at a point much nearer the less narrowed base of the spathe.

Sisyrinchium Asheianum

Caespitose in close tufts, 20–30 cm. high, not fibrillose-coated at base, pale green and glaucescent, the leaf sheathes and spathes purplish to deep wine-purple; leaves half the height of the stem or longer, erect, 0.5–1.5 mm. wide, close-striate, smooth or sometimes roughened, tapering to a hardened acute or obtusely pointed tip: stems mostly about 1 mm. wide, the margins distinctly few-striate, the edges smooth or denticulate: spathes twin, or even three together, or in reduced stems sometimes solitary, sessile at the top of the stem and subtended by an erect bracteal leaf 2–6 cm.

long; bracts of spathes subequal, 10–16 mm. long, distinctly nerved, glabrous or slightly roughened with minute often purplish points, abruptly scarious obtuse and apiculate to attenuate; inner bract of outer spathe equaling or mostly exceeding the outer one; interior scales silvery white, from half to three quarters the length of the bracts; flowers on hair-like exserted pedicels usually subspreading from the top of the spathe; perianth deep violet-blue, 7–10 mm. long, stamineal column 4–5 mm. high: fruit not seen.

NORTH CAROLINA: Salisbury, Rowan Co., April 28, 1897, in wet meadows. Biltmore Herbarium.

Intermediate in appearance with *S. mucronatum* and *S. scabrellum* and related also to *S. albidum* and *S. capillare*. From *S. mucronatum* it is distinguishable at once by its geminate spathes without regard to other characters. *S. albidum* differs in brighter green color, broader, softer and less striate leaves and stem, larger spathes with the broader base passing more abruptly across the sides of the stem and with the bracts greener and more herbaceous and attenuate, less exserted pedicels, paler or white and larger flowers. *S. capillare* is altogether more slender and delicate, and differs further in fibrillose-coated base, merely margined stem, and smaller spathes having narrower more attenuate bracts broadly white hyaline on the margins.

S. Asheianum clearly bears a very close relationship to *S. scabrellum* but is mostly a much lower plant with narrower leaves and stem, less slender roots, more highly colored bracts which are much less herbaceous and attenuate, and smaller, deeper blue flowers; it is moreover either quite glabrous throughout or with only obscure indications of the scabrellous investiture of bracts and leaves which is so noteworthy a character of *S. scabrellum*. The latter, as recorded on collectors' labels, is a plant of dry woodlands, *S. Asheianum* of wet meadows.

Named for Mr. W. Willard Ashe, whose collection of southern *Sisyrinchia* has furnished several new species and who was himself about to publish as new the plant here described.

Sisyrinchium capillare

Extremely slender and delicate, growing in erect thin tufts 20–45 cm. high, closely erect-fibrillose at base; glaucescent, drying a dull olive-green, the spathes and leaf-bases often tinged with pale dull purple; roots slender and wiry. Leaves from half to three

quarters the height of the stems, closely erect, almost filamentary, mostly .05 mm. or less wide and strongly 2–4-striate, very smooth, attenuate-acute, in age often developing hardened tips: stems equally slender with the leaves, wiry and subterete, not winged but narrowly firm-margined, the edges smooth: spathes mostly two or sometimes single, rarely three together, sessile at the top of the stem and closely subtended by an elongated primary bract, very small, 10–13 mm. long, the bracts subequal, mostly very acute or aculeate, somewhat membranous but distinctly nerved, glabrous, the margins conspicuously white-hyaline; primary bract straight and setaceously slender, usually much elongated, 2–8.5 cm. long, the edges narrowly white-hyaline towards the striate base which is on both sides rather abruptly broader than the stem; interior scales silvery-white, usually but little shorter than the bracts: flowers light violet-blue on slenderly exserted, loosely erect, or finally flexuously spreading pedicels; perianth 6–8 mm. long; stamineal column about 4 mm. high: capsules pale, subglobose, 2–3 mm. high; seeds irregularly obovoid-subglobose, black, distinctly alveolate, about .75 mm. in diameter.

NORTH CAROLINA to Florida, mostly in flat sandy woods, flowering in April and May.

NORTH CAROLINA: "Read," Herb. Acad. Nat. Sci. Phil.: Selma, April, 1899, W. W. Ashe.

SOUTH CAROLINA: Aiken, May, 1899, W. W. Ashe.

GEORGIA: Brunswick, April 16, 1899, W. W. Ashe.

FLORIDA: South of Jacksonville, fourteen and twenty miles, May 13 and 18, 1899, W. W. Ashe.

An exceedingly delicate plant, being one of the most slender species of the entire genus. In its most slender state, the stems and leaves appear almost thread-form, yet the plant may be equally tall with some of the stoutest species.

Sisyrinchium dichotomum

Dull yellowish-green and glaucescent, not turning dark when dry, 30–40 cm. high, in thin erect tufts, not fibrose-coated at base, the roots slender and simple or nearly so. Leaves rather few, mostly about half the height of the plant, or a few longer, somewhat openly erect, 2–6 mm. wide, often broadened upward to above the middle and tapering-acuminate, rather thin but firm, minutely crystalline-puncticulate, the broader ones somewhat distantly striate-nerved, the edges very minutely close-serrulate to nearly smooth: stems broadly thin-winged and similar to the

leaves: inflorescence more or less dichotomous from 2–4 series of nodes, the primary node often below the middle of the plant; leaves of the lower nodes very prominent, elongated and acuminate, manifestly broadened about the middle, sometimes even wider than the basal leaves; branches slightly diverging, usually only one of each pair forked, at least above the first or second node, the lower nodes usually bearing also 2–3 slender, often curved peduncles sometimes over 10 cm. long; uppermost peduncles 3–5 cm. long, often very slender and curved; lower branches 6–12 cm. long, broadly winged, the upper series increasingly shorter and more slender: spathes green, very small, often scarcely broader than the peduncles and keeled on either side of the narrowed base by its ascending wings, straight, the bracts very narrow, thin and weakly few-nerved, sharp edged, more or less unequal; outer bract slenderly attenuate, mostly prolonged beyond the inner one for 2–7 mm., the edges very narrowly white-hyaline below, united-clasping for 2–3 mm. at base; inner bract 8–15 mm. long, slender-pointed; flowers 3–9, white in the only specimens seen, very small, perianth about 5 mm. long, stamineal-column 2–3 mm. high: capsules rather pale and thin-walled, trigonous-subglobose or obovoid, about 3 mm. high on very slender, flexuously-erect, exserted pedicels 15–23 mm. long; seeds only 1–2 in each cell, large, 1.5–2 mm. in diameter, somewhat flattened-subglobose or obovoid, often bluntly angled, strongly umbilicate, black, at first rugulose, but becoming smooth or nearly so and even somewhat shining.

NORTH CAROLINA: Chimney Rock, Rutherford Co., May 11, 1899, fruit mature and only a few flowers remaining. Biltmore Herb.

A rather remarkable species, especially noteworthy by reason of its successively dichotomous system of branching, ample stem-leaves, very small white flowers, small capsules and few large seeds. Apart from its much greater amount of branching its general aspect is perhaps most like that of *S. graminoides* or forms of *S. Carolinianum*, though it may be more nearly related to the following species. It has smaller flowers, broader stem-leaves and fewer larger seeds, than any other eastern species known to me.

Sisyrinchium tenellum

Growing in loose often leafy tufts 15–30 cm. high, not fibrose-coated at base, rather dark dull green, apparently not even glaucescent, usually turning dark in drying; roots soft and slender. Leaves often equaling the stems though sometimes only half as high, very thin and grass-like, soft and openly erect or sometimes

firmer and strictly erect, 1–3 mm. or even 4 mm. wide, tapering and cuspidate, acute, distinctly few-nerved with fainter nerves in the very wide interspaces, the edges, as are those of the stem, very smooth or, sometimes, ciliolate-serrulate; stem 1–3.5 mm. wide, loosely erect, weak and very flat mostly with broad thin wings nerved like the leaves; nodes one or two, when two the lower one sometimes below the middle of the stem; bracteal leaves erect, usually long and narrow and surpassing the peduncles but sometimes much shorter; peduncles one or two, seldom three, diverging, subequal or very unequal, 3–12 cm. long, slender, but flat and wing-margined, mostly under 1 mm. wide, sometimes nearly filiform, the edges smooth to ciliolate-denticulate: spathes green, often abruptly deflected, small and narrow, not seldom scarcely broader than the peduncle; bracts membranous, weakly or obscurely few-nerved, slenderly attenuate and very acute, or sometimes the inner one apiculate from a somewhat scarious apex, the outer one usually more or less prolonged; outer bract 12–25 mm. long, mostly surpassing the inner one 2–10 mm., but sometimes subequal with it, slenderly attenuate, the margins narrowly white-hyaline, united-clasping for 2–5 mm. at base: inner bract usually closely appressed, under 1.5 mm. long: interior scales half the length of the spathes or less, becoming brownish tinged: flowers 3–5, violet-blue, distinctly fine-nerved, very small, perianth 5–8 mm. long, stamineal column 2.5–4 mm. high: capsules dark, subglobose, very small, 1.5–3 mm. high, on hairlike exserted pedicels somewhat spreading above; seeds only 2–3 in each cell, globose, rough, only obscurely if at all umbilicate, very small, about .75 mm. in diameter.

Alabama and Georgia, in moist soil, flowering in May and June.

ALABAMA: Lee Co., Auburn, several collections by F. S. Earle, C. F. Baker, and L. M. Underwood, 1896–99, in Herb. F. S. Earle, Ala. Biol. Survey and Columbia University.

GEORGIA: Floyd Co., Silver Creek, May 8, 1899, Biltmore Herb.; Jefferson Co., Louisville, Hopkins, Herb. Miss. Bot. Gard.

An interesting species in close relationship with *S. graminoides*, but smaller, with generally much narrower stems and leaves, much smaller flowers and capsules, and fewer smaller seeds; the leaves and stem are also thinner and softer and usually quite without serrulate edges, the leaves more tapering-acute, the small spathes relatively narrower and often or usually abruptly deflected, the bracts commonly more narrowly attenuate and unequal, the pedicels less exserted and flexuous.

The few-seeded capsules are suggestive of *S. dichotomum* to which, in other respects, the species seems to be related, but not so closely as to need detailed comparison.

The above description of the species has been considerably modified to accommodate the collection cited from Silver Creek, Georgia, represented by a very full sheet of specimens. These differ from all the others in serrulate edges of stem and leaf, more slender peduncles uniformly much surpassing the bracteal leaves, rather broader and straighter spathes of less attenuate subequal bracts, the outer one less united clasping, the inner one mostly abruptly pointed from a scarious tip. It is quite possible that this plant merits separate recognition.

Sisyrinchium membranaceum

Rather low, 20–25 cm. high, and loosely erect or assurgent in thin tufts not fibrose at base, arising from rather loosely short-branched rootstocks, the roots slender and nearly simple: plant scarcely if at all glaucescent, becoming dull brownish-green on the herbarium sheet. Leaves loosely suberect, half the height of the stem or more, 1.5–3.5 mm. wide, cuspidate-acute, very thin and membranous, becoming somewhat shining when dry, delicately but prominently few-nerved with a secondary series of faint nerves in the interspaces which are very minutely and closely crystalline-puncticulate, edges of the leaves mostly minutely close-serrulate: stem similar to the leaves, broadly thin-winged, the raised line of the proper stem very narrow: node one, rarely two, bearing a short erect bracteal leaf 2–6 cm. long, and two slender peduncles 4–10 cm. long, frequently longer than the stem: peduncles flat, wing-margined and serrulate-roughened, distinctly constricted transversely below the spathes, the outer one slightly diverging, often only half the length of the erect inner one: spathes green or tinged with purple, slightly deflected or straight, the subequal bracts thin and membranous and delicately or obscurely veined, rather sharply keeled and almost cuspidate-acute, mostly 15 mm. or less long (13–18 mm.) either one slightly the longer, the outer one narrowly attenuate, very narrowly hyaline-edged, united-clasping below for 4–6 mm., sometimes for half its length: inner bract rather broader above and more abruptly acute: interior scales often equaling the bracts or nearly so, but sometimes much shorter, brownish-tinged: flowers 3–5, violet-blue, perianth rather firm and shining membranous in the dried specimens, the segments obovate-oblong, delicately firm-nerved, slenderly aristulate, 10–12 mm. long:

stamineal-column 5 mm. long, anthers small: capsules dark, trigonous-subglobose, 3–5 mm. high, on delicate slenderly exserted pedicels, erect to widely spreading above; seeds only 2–3 in each cell, immature but evidently large.

FLORIDA: Jackson Co., Marianna, April 20, 1899, in full flower; rich shaded soil. Biltmore Herb.

The relationship of this species is with *S. graminoides* and *S. tenellum*. From the latter it is distinguished at once by much larger flowers and capsules without regard to other characters. The flowers are also rather larger than in *S. graminoides* with the broader segments apparently of a more firmly membranous textuae as also are the more strongly few-nerved leaves; the bracteal leaf is much shorter and less foliaceous, the peduncles relatively longer and the often deflected spathes much smaller, with less herbaceous bracts, the outer one more united, clasping below; the interior scales, though variable, become much longer than they are ever seen in *S. graminoides* and the few and larger seeds are a further noteworthy point of difference. The whole plant is lower and less erect than *S. graminoides* and with a more loosely branched underground system.

Sisyrinchium flexile

Tall and slender, about 50 cm. high, apparently in thin tufts, not fibrose-coated at base, pale green but only slightly if at all glaucous. Leaves long and slender, the longer ones equaling the stems or nearly so, rather stiffly erect, withering-persistent, 1.5 mm. wide, closely few-striate, somewhat obtusely pointed with a hardened tip, at least in age, very smooth throughout: stems equally smooth and slender with the leaves, somewhat flexuously erect, subterete and very narrowly firm-margined; nodes one or two, distinctly swollen, when two the lower one bearing a somewhat geniculate slender branch, nearly terete, with slightly roughened margins and a narrow bracteal leaf, the upper node bearing a very short bracteal leaf, sometimes with hardened incurved apex, and two delicate, nearly terete, slightly geniculate peduncles, 3–7 cm. long; spathes pale, slightly deflected, 15 mm. or more long, narrow, especially the subterete base, the bracts subequal, closely striate, their narrow tips scarious-obtuse or sometimes short-apiculate, the inner one sometimes the longer; interior scales silvery white, ½–¾ the length of the bracts; flowers unknown: capsules 5–10, dark brown and rather thick-walled, broadly oblong or

obovoid-oblong, 4–6 mm. high, on erect, more or less exserted pedicels slightly spreading above; seeds numerous, very small, .05–1 mm. in diameter, black, alveolate, umbilicate.

MISSISSIPPI: Petit Bois Island, May 8, 1898, with mature fruit, S. M. Tracy.

A very slender species especially characterized by flexuously elongated stems and leaves, peculiarly thickened nodes, scarious-obtuse bracts and very small seeds. It appears to be nearest to *S. Atlanticum*, but possesses many points of difference. In addition to those above referred to may be noted its less glaucous character, firmer and more wiry and subterete narrowly margined stem, narrower spathes of stiffer, less membranous, and more closely striate-nerved bracts, larger capsules. In the two scant specimens, which alone have afforded the outlines of the species, the shortened and scarious-obtuse, outer bract appears to represent a perfectly normal condition; should it prove to be constant it will afford a unique distinctive character among our species.

Sisyrinchium Tracyi

Pale green and slightly glaucescent, discoloring somewhat in drying, rather stout and stiff, 35–70 cm. high, bearing some loose stiff fibers about the base but not densely fibrose-coated; leaves about ¾ the height of the plant or longer, firm and erect, 1–3 mm. wide, close-striate, becoming faintly rugulose, tapering-acute, very smooth throughout: stems rigid, straight or outcurved, 1.5–3 mm. wide, subterete and narrowly firm margined, very smooth; inflorescence stiff and, at least in its early stage, appearing somewhat contracted-sub-paniculate, the lower node bearing one to three erect peduncles and one or two stiff, mostly short branches supporting a cluster of 3 or 4 peduncles; branches subterete and merely margined, smooth or obscurely denticulate, erect or ascending, 4–9 cm. long, the peduncles slender but stiff, approximate, those from the upper nodes 3–5 cm. long; lower bracteal leaf elongated and erect, equaling its inflorescence or shorter, sometimes 16 cm. long; upper bracteal leaves short and stiff: spathes green, sometimes slightly deflected from the abruptly constricted top of the peduncle, about 3 mm. wide, the flattened base rather sharply two-edged, the bracts strongly close-striate, subequal, 15–22 mm. long, the outer one herbaceous or abruptly short-acuminate, the margins white-hyaline, united clasping below for about 5 mm., the inner bract mostly apiculate from a thin scarious-obtuse or truncate apex; interior-scales silvery white,

broad, ½ to ¾ the length of the bracts: flowers on erect, scarcely exserted pedicels, violet-blue, the perianth 10–12 mm. long, with long-aristulate segments; stamineal column 5–6 mm. high; fruit not seen.

MISSISSIPPI: Biloxi, March 20, 1898, just in flower, S. M. Tracy.

A rather stout and stiffly erect species, perhaps more suggestive of *S. Atlanticum* than any other but showing material differences. Unlike *S. Atlanticum* it is scarcely if at all glaucous, and has a very rigid and subterete merely margined stem and longer stiffer leaves; the bracteal leaves are more foliaceous and the subpaniculate inflorescence stiffer and more contracted, with the bracts of the spathe thicker and more closely striate-nerved.

Named for Prof. S. M. Tracy whose collections of Mississippi *Sisyrinchia* have furnished several new species.

Sisyrinchium nanum

Described from a single specimen, probably untypical. Low and stiff, 12 cm. high, pale green and glaucous, not at all fibrillose at base, the long descending roots nearly simple and slightly thickened: leaves erect, some of them equaling or surpassing the stems, 1–2 mm. wide, prominently close-striate, tapering to a stiffened subterete, acute apex, very smooth, or sometimes, when young, roughened on the sides with minute points and with denticulate edges, firmly membranous below and abruptly expanded-clasping at the extreme base: stems subterete and stiff with firm narrow margins, the edges smooth; node only one, bearing an erect leaf about equaling the single short outcurved peduncle; peduncles about 3 cm. long, very narrowly margined, smooth-edged or obscurely denticulate, constricted below the spathe; spathes 13 mm. long, narrowed below; bracts closely striate-nerved, the outer one narrowed to a short-pointed apex, the margins broadly white-hyaline to the tip, united-clasping for 5 mm. below; inner bract prominently surpassing the outer one, broadly scarious obtuse and abruptly contracted to the short-apiculate apex, interior scales broad, acuminate, the longer equaling or exceeding the outer bract; flowers apparently few, on slightly exerted pedicels, bright violet-blue, about 10 mm. long; stamineal column 4 mm. high.

MISSISSIPPI: Horn Island, June 1, 1898, Prof. S. M. Tracy.

The specimen cited is a very small plant only just in flower, and it is scarcely probable that it is fairly representative of its

species. Ordinarily there would be little excuse for proposing a new species on so slender a basis, but I have the less hesitation in so doing in the present case because it is impossible to reconcile the specimen with any species known to me and the exact locality where it was collected being known the true status and relationship of the plant can be readily ascertained at some future time.

It is to be compared especially with *S. tortum*, agreeing with that species in the short stamineal column; but it differs obviously in other characters, notably in the entire absence of the fibrous investiture of the base of the tufts.

A new Volutella

By Judson F. Clark

(Plate 371)

This fungus was found growing on dead leaves of *Pandanus Veitchii* in the greenhouses of the Botanical Department, Cornell University. Pure cultures were obtained by the ordinary dilution method, and germination and developmental phenomona were studied by growing the fungus in hanging-drop cultures in Van Tieghem cells.

An excellent medium for the development of this form was made by steeping 450 grams of sugar beet, sliced thin, in a liter of water for three hours at 100° C. After straining and cooling, the whites of two eggs were added, and the infusion was again boiled, then strained and filtered. To half the liter was added 6 grams of agar for a solid medium. This infusion of sugar beet and its corresponding agar were used with great satisfaction for the development of various fungi, and were found to be particularly well adapted for the development of many saprophytic forms.

Hanging-drops of the infusion and the agar were inoculated with a few spores from a pure culture. At 6 hrs. (Temp. 28° C.) the spores were germinating freely. The germ tubes were invariably developed from the ends of the conidia (*Plate 371, f. 3*) and in the first stages appeared to be simply a bulging out of the hyaline wall at these points. Two hours later the germ tubes had reached a length of about 20 μ and were beginning to branch by developing a branch close to the end of the original conidium, which could still be distinguished from the germ tubes by its greater diameter. This peculiarity of the first branching (*f. 4*) was quite constant in all cases observed. At 15 hours the cultures presented a mass of well branched, vigorously growing, non-septate mycelium.

At from 24 to 36 hours conidial fructifications of two distinct types made their appearance. The first to appear were the larger submerged sporophores bearing macroconidia. In origin, mode

of development, and appearance they resembled the aërial sporophores developed later, but differed from them in size, submerged habit, and character and number of conidia borne. In Fig. 5 is shown a branch of mycelium bearing the macrosporophores, two of which have developed conidia. This drawing was made from a culture in agar where the conidia were held *in situ* by the medium and could be counted. In general each macrosporophore produced 8–12 macroconidia. These latter were rather irregular in shape, varied greatly in size, and were obscurely two-guttate in appearance. The measurements varied from 3.5 $\mu \times 7\ \mu$ to 4.5 $\mu \times 18\ \mu$. Several of these macroconidia are shown in Fig. 2. In germination phenomena they were quite similar to the microconidia.

Some hours after the first appearance of the macrosporophores, smaller, aërial microsporophores were very abundantly developed. These were borne laterally on submerged, and laterally and terminally on aërial hyphae, and abstricted conidia from their apices exactly similar to those examined from the original sporodochia on leaves of *Pandanus*. In figures 6–9 the manner of development of these conidia is shown, and how they remain clustered at the apex of the sporophore, held in position by capillary moisture forming a mucro-like aggregation which sometimes contained a hundred or more microconidia.

On the tenth day sporodochia were observed in the agar cultures. The earliest stage observed was the development of a number of sporophores, in close proximity, bearing a large aggregation of conidia showing in mass a light honey color. Later, the characteristic setae began to make their appearance. Originating in the mass of hyphae near or at the base of the sporodochium, they passed outwards and upwards at varying angles emerging through the spore masses at varying points. The mature sporodochia in these cultures resembled very closely those originally found on *Pandanus*, but differed in having a somewhat more regular appearance and a richer yellow color, variations due no doubt to the altered conditions of development.

On sterile bean pods and sugar beet plugs the growth and conidial fructification was excellent, and quite similar to that already described for the sugar beet infusion and agar. No indication of a perfect (ascus) stage was observed.

The growth on plate cultures was quite characteristic. The center of the colony produced a bunch of fluffy aërial hyphae which was surrounded by a compact ring of rich lemon yellow spore masses, beyond which the mycelium grew out in radiating lines bearing innumerable sporophores and an occasional sporodochium. That this fungus is quite sensitive to changes of tem-

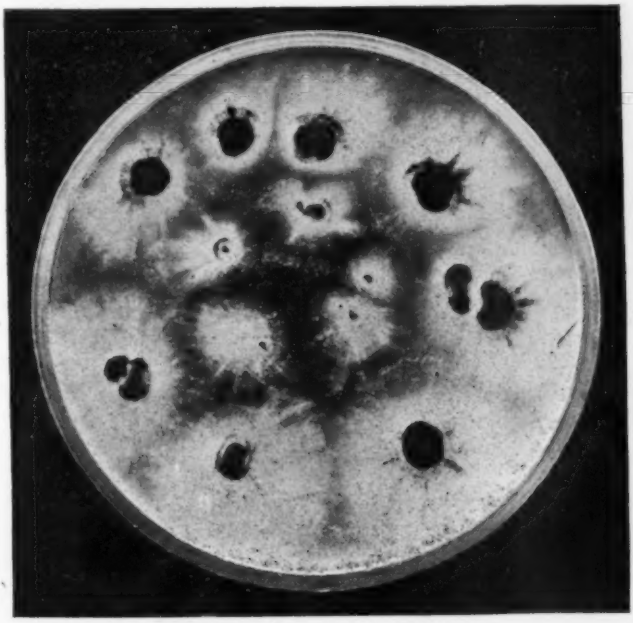

Plate culture of *V. mellea* on sugar beet agar. Grown at first in thermostat at 28° C., but afterwards on shelf in culture room. The fluffy hyphae in the center of the colonies is obscured by underlying spore masses.

perature was shown by the concentric markings of colonies in Petrie dishes kept in the laboratory where the temperature varied frequently and considerably during the development of the colonies.

Volutella mellea sp. nov.

Sporodochia substipate, irregularly hemispherical, at first white, then honey-colored, becoming brown in age. 100–150 μ in diameter, stratose; setae 10–60, arising irregularly from base of sporodochium and in many cases passing upwards through it, hyaline, continuous, slightly curved, tapering, very slightly roughened,

200–500 μ long x 2–7 μ in diameter; sporophores simple, continuous or rarely 1-septate, always cut off from the hypha by septum, 30–70 μ long, tapering from 2 ½ μ at base to 1 ½ μ at apex; conidia hyaline (when viewed singly), oblong, 2–2 ½ μ x 4–7μ, 2-guttate, forming great masses on top of sporodochium.

The species in many particulars resembles closely *V. ciliata* Fr., but differs from it in several important particulars as follow:

VOLUTELLA MELLEA.	VOLUTELLA CILIATA Fr.
Sporodochia at first white, becoming yellow later.	*Sporodochia* albo-carneis.
Stratose.	
Microsporophores 30 to 70 μ x 2 ½ μ at base to 1 ½ μ at apex. *Macrosporophores* somewhat larger.	Sporophores 10 to 15 μ x 1 μ.
Hyaline to honey-colored.	Hyaline or dilutely rose.
Microconidia distinctly 2-guttate.	
Macroconidia obscurely 2-guttate.	
On *Pandanus*.	On *Dicotyledons*.

BOTANICAL DEPARTMENT, CORNELL UNIVERSITY.

Explanation of Plate 371

1. Microconidia, × 500.
2. Macroconidia, × 500.
3. Microconidia germinating, × 600.
4. First branching of germ tubes.
5. Branch of mycelium bearing macrosporophores, from culture in sugar beet agar, × 500.
6–9. Microsporophores, showing different stages in the development of a "head" of microconidia, × 500.
10. A young sporodochium (diagrammatic), × 250.
11. A mature sporodochium, many of the spores removed, showing the stratose structure (diagrammatic), × 250.

New and interesting Plants from Western North America.—VIII

By A. A. Heller

Microsteris MacDougalii sp. nov.

Annual, spreading, puberulent or pubescent with short hairs: stem much branched from near the base, 15 cm. high or less, the spread of the branches equalling the height: leaves alternate, usually at the base of a branch, lanceolate, or linear-lanceolate, the lower larger ones 2 cm. long, 2–3 mm. wide: pedicels slender, usually quite short: calyx 5 mm. high, the linear-lanceolate lobes splitting to the base, scarious-edged below, the tips acuminate and cuspidate: corolla pale pink, very small, the tube scarcely or at all exceeding the calyx, the lobes very short: seeds olive-brown.

Dr. D. T. MacDougal's no. 42, collected on "dry hills north of Flagstaff," Arizona, June 3, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden.

In habit this species is like the northern *M. diffusa*, but very different in other particulars. It is peculiar in having a calyx with lobes split to the base.

Brittonastrum pallidiflorum sp. nov.

Lower portion of stem not seen, the upper portion cinereous puberulent, cymosely branched: branches slender, leafy, 2 dm. or more in length: leaves scattered, opposite, coriaceous, roughened with very short hairs, resinous dotted, the lower ones 4 cm. long, including the petiole, 2.5 cm. wide, broadly ovate, obtuse, cordate at base, crenulate, the petioles 1.5 cm. long, ciliate; leaves of the upper part of the branches smaller, ovate or ovate-lanceolate, acute, somewhat contracted at base, dentate, short-petioled, or the uppermost sessile: spikes 3–5 cm. long, dense, the peduncles and pedicels very short, only about 1 mm. long; bracts equalling or exceeding the calyx, lanceolate or linear-lanceolate, puberulent, ciliate, acuminate; calyx 7 mm. long, about 18-nerved, puberulent resinous dotted, somewhat two-lipped, the lobes lanceolate, acute, whitish, the two lower ones usually slightly shorter than the three upper ones; corolla 14 mm. long, slender, its tube exserted, puberulent or shortly pubescent, upper lip erect, the two lobes short, rounded, the lower lip spreading, with the middle lobe much longer than the lateral ones; stamens and style exserted; style two-lobed.

The type, preserved in the herbarium of the New York Botanical Garden, is Dr. D. T. MacDougal's no. 313, collected in a "cañon near the eastern base of Bill Williams Mountain, Arizona, July 22, 1898."

This species should, perhaps, be described as *Agastache pallidiflora*, as it has considerable resemblance to *Agastache*, especially in the appearance of the spikes. It has, however, the slender, exserted corolla and narrow bracts of *Brittonastrum*, and geographically would seem rather to belong to that genus. It seems to be a connecting link between these closely related genera.

Senecio Hartianus sp. nov.

Perennial, sometimes propagating by underground stolons: stem simple, erect, 3–4 dm. high, lanate, becoming smoother with age: leaves mostly basal, these oval, 12–18 mm. long, some cordate on petioles 1 cm. long, others narrowed into a petiole 3–4 cm. long, finely serrate; stem leaves few, scattered, four to six in number, the lowest lanceolate, petioled, about 3 cm. long, the others linear, sessile, bract-like, all floccose, becoming glabrate with age: heads 4–6 in a terminal corymb; pedicels slender, 1–3 cm. long, somewhat lanate; involucre 5 mm. high, lanate, or becoming glabrate, its bracts linear-lanceolate, acuminate, tipped with purple; rays about 15, oblong, bright yellow, 4 mm. long, 1 mm. wide: achene glabrous: pappus bright white.

No. 230, collected by Dr D. T. MacDougal, "in valley in open woods near Hart Spring, San Francisco Mountain, near Flagstaff, Arizona, July 5, 1898. The type specimen is deposited in the herbarium of the New York Botanical Garden., A well-marked species of the *S. aureus* group.

SOME LONG-STYLED SPECIES OF DRABA

Certain remarks lately printed by Prof. E. L. Greene in Pittonia concerning the trustworthiness of the statement "authentic specimen from type locality," as printed on some of my labels belonging to the New Mexican collection of 1897, led me to look up the type sheet of *Draba aurea* var. *stylosa*.

I wish to express my thanks to Dr. B. L. Robinson for the privilege of examining this type sheet, as well as the other material in the Gray Herbarium which is associated with it under the

varietal name. The investigation of this material, as well as that in the herbaria of the New York Botanical Garden and of Columbia University, which latter contains a sheet of Fendler's no. 43, upon which the variety was founded, proved very interesting. It showed that a number of distinct forms have been included under one name, not only in the original collection, but among later collections as well. Some of these have already been segregated by Professor Greene, but there are others which seem equally worthy of characterization.

DRABA HELLERIANA Greene, Pittonia, **4**: 17. 1899

Draba aurea var. *stylosa* A. Gray, Amer. Journ. Sci. II. **33**: 243. 1862, in part.

Draba stylosa Heller, Plant World, **1**: 23. 1897. Not *D. stylosa* Turcz. 1854.

When the writer raised *Draba aurea* var. *stylosa* of Gray to specific rank in 1897, he failed to note that the name was invalidated by previous use. In the recent diagnosis of *Draba Helleriana* by Professor Greene, our no. 3669, an "authentic specimen from type locality," and Professor Wooton's no. 275, collected in the White mountains, Lincoln county, southeastern New Mexico, were cited as types.

After the description, Professor Greene further remarks that "Mr. Heller's statement, printed on his labels 'Authentic specimen, from type locality,' is mere bombast. Fendler collected no such plant as this; and Mr. Heller did not find the subalpine Fendlerian type on which Gray founded his *D. aurea* var. *stylosa*."

Perhaps my investigations have been very superficial, but so far I have failed to discover Professor Greene's reason for the *positive* assertion that "Fendler collected no such plant as this." Probably Professor Greene has not seen the type sheet of *D. aurea* var. *stylosa*, for on it are two fine examples of this same *D. Helleriana*, and the label says Fendler collected them. Mr. Fendler's field note also shows that he collected this particular form, for the latter part of it reads: "More rarely in the creek bottom and low banks of the creek." In the rich soil on the "low banks of the creek," is exactly where the specimen of mine which Professor Greene has seen, was obtained, and necessarily near the spot of

original collection, a fact needing no explanation to one familiar with the topography of Santa Fe cañon. There is also an example of this species in the herbarium of Columbia University, under Fendler's no. 43.

Draba patens sp. nov.

Annual or biennial: stems rather stout, 4 dm. high when mature, branched in the upper three fourths, the branches patent, markedly hirsute with mostly simple hairs, leafy throughout, even on the flowering branches: leaves rather thin, light green, the lowest ones obovate or spatulate, about 2.5 cm. long, 1 cm. wide, petioled, the petioles ciliate; the others ovate-oblong or ovate-lanceolate, acutish or the upper ones acute, sessile at the broad base, roughened on both sides with very short hairs, serrate with prominent spreading teeth, these wanting near the base, especially on the leaves of the lower part of the stem; those on the middle portion of the stem the largest, 3–3.5 cm. long, 1.5 cm. wide: branches bearing flowers and fruit having a spread of 15 cm.: calyx yellowish, the lobes oblong, obtuse, 2 mm. long, somewhat pubescent: petals bright yellow, oblong, twice the length of the calyx: fruiting pedicels slender, pubescent, 5 mm. long; pod twisted, pubescent with short hairs, about 1 cm. long, tipped with a prominent slender style.

The type is Professor E. O. Wooton's no. 275, preserved in the herbarium of the New York Botanical Garden.

This number is cited by Professor Greene as part of his *D. Helleriana*, but the specimen here described is certainly different from my no. 3669, and from Fendler's original in the Gray Herbarium. Professor Wooton's plant differs from mine in its system of branching, not being branched directly from the base, as is mine, but the branches commence some distance above the root, and are widely spread, whereas in my plant the upper branches are strict; the leaf is thinner, broader, of a rather different shape, prominently toothed; the calyx is smoother, and the pods more pubescent.

Since writing the above description, I have seen Professor Wooton's no. 275, as represented in the herbarium of the Missouri Botanical Garden. This specimen differs considerably in general appearance from the one just described, as it has much larger leaves, which are a little thinner, entire, or almost so. It is a marked form, perhaps worthy of varietal rank.

DRABA NEO-MEXICANA Greene, Pittonia, 4: 18. 1899

Draba aurea var. *stylosa* A. Gray, Amer. Journ. Sci. II. **33**: 243. 1862, in part. Not *D. stylosa* Turcz. 1854.

Professor Greene describes this as "a subalpine species, of the mountains back of Santa Fé, New Mexico; this description drawn from Fendler's no. 43 as found in the U. S. Herbarium."

As has been noted above, a large part of Fendler's no. 43 is represented on the type sheet by *D. Helleriana*, but there are also on it two small plants which are evidently *D. Neo-Mexicana*, according to description.

D. Neo-Mexicana is the plant referred to under *D. Helleriana*, where Professor Greene says that "Mr. Heller did not find the subalpine Fendlerian type on which Gray founded his *D. aurea* var. *stylosa*." Professor Greene was not present with me in New Mexico when I made the collection referred to, neither have I ever told him that I did not collect this particular plant; hence he must have merely inferred that I did not, simply because he never saw it under one of my labels.

Neither am I able to see how he could safely accuse a man of "bombast" when he acknowledged in the citation of the type of *D. Neo-Mexicana* that he had seen only one example of Fendler's no. 43—the one in the U. S. National Herbarium—and that not the type of Gray's *D. aurea* var. *stylosa*.

Furthermore, I fail to find any support for the assertion that this is a subalpine plant, any more than is *D. Helleriana*. In the "Plantae Fendlerianae," the locality is given as "shady declivities, along Santa Fé Creek, at the foot of mountains, etc.; May to July." Fendler's field note reads: "8th May–28th July, 1847. Santa Fé Creek, shady steep declivities and foot of mountains. More rarely in the creek bottom and low banks of the creek." Indeed, if a low, stunted growth alone is to be taken as subalpine, such subalpine plants can be produced at sea level within the tropics.

Fendler not only collected *D. Helleriana* and *D. Neo-Mexicana*, two very distinct forms, but also a third less differentiated one, all included under his no. 43. This third form is present on the type sheet of *D. aurea* var *stylosa*, but it is there represented by only one small plant. It is well represented, however, in the George Engelmann Herbarium at the Missouri Botanical Garden. Through the

kindness of Dr. Trelease, I have had the privilege of examining the two sheets of Fendler's no. 43, preserved there. Although averse to the characterizing of varieties, the best way of treating this form seems to be to describe it as a variety.

Draba Neo-Mexicana robusta var. nov.

Multicipitally branched after the manner of *D. Neo-Mexicana*, but with stouter, more pubescent, curved stems, branched above: leaves more numerous and larger. The type in Fendler's no. 43, as represented in the George Engelmann Herbarium at the Missouri Botanical Garden.

Draba pallida sp. nov.

Biennial, or perhaps perennial, somewhat multicipitally branched, cinereous throughout: stems 4 dm. high, beginning to branch near the base, the branches ascending, densely pubescent below with mostly forked hairs, these gradually becoming fewer on the upper parts of the stem, and entirely wanting near the summit: leaves thick and firm, all roughened with a dense, short, stellate pubescence, the basal ones spatulate, clustered in rosettes, entire, about 15 mm. long, 4 mm. wide, tapering into a petiole; those of the stem oblanceolate, 2–3 cm. long, 5–7 mm. wide, sessile, acute, serrate in the upper half with sharp spreading teeth, or the upper reduced ones nearly entire: flowers apparently creamy or white: pedicels slender, strongly divaricate, slightly pubescent, about 5 mm. long: pod equalling or exceeding the pedicel, twisted, glabrous, tipped with a slender style 2 mm. long.

Dr. H. H. Rusby's no. 18, as represented in the herbarium of Columbia University. It was collected on "shady hillsides, Mogollon Mountains, New Mexico, August, 1881."

Draba rubricaulis sp. nov.

Apparently annual: stem 4 dm. high, slender, purplish, branched from near the base, the branches erect, hirsute below with spreading hairs, glabrous above: leaves few, mostly below the branches, thin, light green, sessile, oblong, obtuse, or the smaller upper ones lanceolate, acute, dotted with very short appressed hairs, the veins shortly hirsute, the margin ciliate, the larger ones 3–4 cm. long, 1 cm. wide: branches peduncle-like, subtended by a leaf, naked, or provided with a few short lanceolate bracts about 5 mm. long, the peduncle part 5–10 cm. long, this longer than the flowering portion on the lower branches, one third shorter on the upper ones: pedicels divaricate, slender, glab-

rous, 1.5 cm. long when mature: sepals oblong or ovate, yellowish, glabrous, 2 mm. long: petals yellow, oblong or oblong-spatulate, obtuse, about 5 mm. long: pods spirally twisted, usually with three spirals, normally shorter than the pedicel, moderately pubescent with short hairs, these more noticeable on the margins, tipped with a slender style 2 mm. long.

C. G. Pringle's no. 1529, collected October 1, 1887, on cool ledges, Sierra Madre, State of Chihuahua, Mexico. The type is in the Gray Herbarium. Its nearest relative is, perhaps, *D. patens.*

BEDFORD PARK, NEW YORK CITY.

Anthurus borealis Burt.

By David Griffiths

This rare and interesting fungus so beautifully illustrated and fully described by Prof. E. A. Burt, Mem. Boston Soc. Nat. Hist. **3**: 487–505, has been found in a third locality in the state of New York. It has also been collected in one locality in Massachusetts. This then makes the fourth station in which the fungus has been collected. The last locality has furnished more material than any of the others, besides giving some additional data which are thought worth recording.

The records of the distribution of the plant which have come to my notice are as follows: East Galway, Saratoga Co., N. Y., Sept., 1896, E. A. Burt; Sherruck, Delaware Co., N. Y., Aug., 1897, F. B. Southwick, Annual Rep. State Bot., N. Y., 1897: 132; Waltham, Mass., Autumn of 1898, on authority of G. E. Morris; New York City, N. Y., Oct., 1899.

The first collection made the past season was on the eighth of October, in a rectangular plot of ground at the rear of the Library of Columbia University. The area is planted with ornamental shrubbery, and is completely covered with a thin layer of manure and rubbish used as a mulching for the young shrubbery. The surface of the ground has not been disturbed since early spring. The soil is a yellow clay mixed with considerable sand. There are surrounding the library four of these rectangular areas, one at each of the four angles of the building. The treatment of the soil, the planting and the mulching has been practically the same on the four areas during the season, but the two rear ones alone furnished crops of *Anthurus*. The one at the northeast corner produced but about a half dozen plants, but the one at the northwest corner furnished a great number. The locality where the plants were developed in abundance was, therefore, a shaded one, partially protected on all sides by buildings and trees.

It is certain that some plants matured and decayed before their presence was discovered; but the activity of several collectors in the vicinity would reduce the probability of their appearance to not earlier than the first of October. The last mature plants were collected on the 20th of the same month. On two occasions after this date, however, good sized eggs were secured. The last eggs were obtained on the 26th. These elongated in a moist chamber on the 29th. We can then say that the plant appeared approximately during the entire month of October. Doubtless the sudden decline of the temperature from the 19th to the 22d, the drouth which prevailed from this period onward, and the continual disturbance of the ground in search for the eggs all contributed to prevent further development after the 20th.

An abundance of material in various stages of development has been preserved. No less than two dozen eggs were allowed to develop in a moist chamber. One not over 1½ cm. in diameter produced an apparently normal plant of but 6 cm. in length. Several smaller eggs than this were secured, but none of them developed. The smallest egg seen was 3 mm. in diameter. The largest plant secured was one which developed naturally on the campus. It measured a little more than 19 cm. in length. The largest plant in the accompanying cut developed in a moist cham-

ber from one of the largest eggs gathered. It measured 16 cm. in length. Fully 60 plants were seen during the month; making allowance for those which decayed unseen, there probably developed 75–100 plants on this small piece of ground.

Eggs considerably developed possess an enormous amount of vitality as evinced by the readiness with which they developed in a moist chamber after being separated from the mycelium. But this is true to a greater or less degree of many if not all of the phallales. One egg which had lain in a moist chamber for two days was cut in two in a median longitudinal plane one morning at 9 o'clock. The two sections were laid on a white piece of paper with the cut surfaces uppermost and placed in a south window to dry, for the purpose of making herbarium specimens of them. Although they remained in the window all day, and in direct sunlight not less than four hours, they elongated during the following night. The cut surfaces of the stipe were dried so that they could not elongate much, but the convex side of the sections elongated to nearly the normal length, and curved around the cut surface making semicircular figures.

Several methods of preservation were resorted to, but the one adopted by Professor Underwood was, on the whole, the most satisfactory, particularly for exhibition purposes; this consisted in stuffing the stipe with cotton and then fixing in 60% alcohol. A strong solution of formalin, 15–30%, gave fairly good results also, but a considerable amount of contraction occurred with all of the fixatives used.

It is fortunate that the plot of ground on which the fungus grew is so favorably situated. It will in all probability remain in practically the same condition as it is now for some time, thus giving an opportunity of studying the plant in the same locality for two or more successive years. It will be interesting to know whether, under favorable circumstances, the plant will appear again in the same locality next year.

Usually the eggs were found aggregated in groups of two to five. The mycelium was very abundant under the mulching, but the eggs were always more or less imbedded in the ground, and always connected with it by strong mycelial strands. The great variation in size has already been mentioned, but this was not

necessarily the result of artificial development in a moist chamber, for several very small plants, about 8 cm. in length, were found developed under natural conditions. These, however, as a rule, grew beyond the mulching in the edge of the grass. The number of branches of the receptacle is quite variable. Professor Burt described the plant with five fully developed branches and one abortive one. While this is apparently the normal condition in our specimens, a large number were found with seven arms and a few with eight. But whether with six, seven or eight, the abortive or smaller branch is nearly always present.

The accompanying cut was made from a photograph by Dr. C. C. Curtis, taken from plants which elongated in a moist chamber. The plant in the center of the figure and the one next to it on the right are fully extended. The outside objects are medium sized eggs. The figures are reduced to a little less than one half natural size.

COLUMBIA UNIVERSITY, Nov. 15, 1899.

Some Fungi from South America

By F. S. Earle

Professor C. F. Baker has placed in my hands for determination a small lot of fungi collected during the fall of 1898 near Santa Marta, United States of Colombia. I am indebted to Mr. A. P. Morgan for the examination of the Xylariaceae and to Dr. P. Dietel for the determination of the Uredinales, and for the accompanying notes on them.

Coleosporium elephantopodis (Schw.) Thüm.

On *Elephantopus* sp., no. 86.

Puccinia claviformis Thüm.

On *Solanum* sp., no. 76.

Puccinia appendiculata Wint.

On some plant of the Bignoniaceae (?), no. 93.

"The appendages on the stem are poorly developed and are frequently wanting, yet I think it is easy to see that this determination is correct."

Puccinia bombacis Dietel sp. nov.

Sori hypophylli, sparsi, mediocres, pulvinati, firmi, brunnei; teleutosporae oblongae vel ellipsoideae, utrinque rotundatae, varius basi attenuatae, ad septum paulo vel vix constrictae, 30–40 × 13–18 μ, episporio dilute bruneo levi, apice incrassato indentae pedicillo firmo usque 50 μ longo suffulto.

On *Bombax* sp., no. 80.

"This is a *Leptopuccinia* which has the appearance of *Puccinia malvacearum* Mart., but has much smaller spores."

Uromyces manihotis P. Henn.—Uredo

"Hennings has only described the telentospores but on specimens received from him I also find the uredospores which correspond exactly with this no. 84."

Uromyces cissampelidis Dietel sp. nov.

Sori hypophylli, minuti, sparsi, uredosporiferi cinnamomei, teleutosporiferi atrofusci; uredosporae obovatae vel subglobosae,

20–26 × 19–23 μ echinulatae brunneae. Teleutosporae ellipsoideae vel rarius globosae, episporio crasso, levi, apice valde incrassato, obscure castaneo indute, pedicello usque 40 μ longo donatae.

On *Cissampelos* sp., no. 83.

SOROSPORIUM SYNTHERISMAE (Schw.) Farl.

On *Andropogon* sp., no. 97.

HYMENOCHAETE PURPUREA Cke. & Morg.

On dead twigs, no. 104.

Auricularia nigra (Schw.) Earle

On dead stumps and logs, nos. 106, 107.

In young specimens the color of the hymenium is ater rather than nigrescent, otherwise the specimens agree well with the description given in Saccardo, Syll. Fung. **6**: 768 (under *Hirneola*). This striking fungus has so much the aspect of a *Peziza* that it is no wonder Schweinitz placed it in that genus.

TRYBLIDIELLA RUFULA (Spreng.) Sacc.?

On dead twigs, no. 103.

Much like this widely distributed and variable species but the ascospores are rather narrow, 24–28 × 7–8 μ, and the disc is black, not at all reddish as is usually the case.

ASTERINA MELASTOMATIS Lev.?

Epiphyllous: perithecia in a scanty radiating brown mycelium, soon confluent, forming black, brittle, somewhat elevated stroma-like crusts, 2–3 or more mm. in diameter, each containing numerous prominent perithecia about 200–300 μ in diameter: asci suborbicular, about 35 × 25 μ, paraphyses none: ascospores inordinate, brown, about equally uniseptate, ends obtuse, 16–20 × 6 μ.

On living leaves of some plant of the Melastomaceae, no. 90.

The description of this species (Saccardo, Syll. Fung. **1**: 51) is too brief and unsatisfactory for positive determination in the absence of authentic specimens. The fact that *Dothidea melastomatis* Kuntze, is given as a probable synonym goes to confirm the correctness of the determination since the mass of confluent perithecia looks much like a black stroma.

PHYLLACHORA GRAMINIS (Pers.) Fckl.

On *Oplismenus*? no. 95.

Apiospora sparsa sp. nov.

Perithecia few, usually one to three or, by confluence, twelve or more, arranged linearly on a scanty inconspicuous subiculum, buried but elevating and rupturing the epidermis, black, small, 150–200 μ, ostiolum papillate-emergent: asci oval, thin-walled, soon ruptured, about 80 × 12–18 μ, paraphyses thread-like, indistinct, soon gelatinized: ascospores obliquely uniseriate or inordinate, narrowly ovate, ends obtuse, straight or slightly curved, hyaline or faintly olivaceous, very unequally two-celled, basal cell about 4 × 4 μ, spore 20–22 × 6 μ.

On the dead culms of some slender grass, no. 105.

HYPOXYLON COCCINEUM Bull.

On dead branches, no. 101 (Det. Morgan).

Hypoxylon Bakeri sp. nov.

Stroma determinate, irregularly rounded, convex, scattered or crowded, about 3–8 mm.: perithecia crowded, covering the entire stroma, globose, prominent, dark brown, black within, large, ¾ mm.; ostiolum minutely papillate, black, shining: asci cylindrical, 60–80 × 5 μ, paraphyses abundant, thread-like: ascospores obliquely monostichous, unequilateral, ends rounded, light brown, 9 × 3–4 μ.

On dead branches, no. 87.

Marsonia agaves sp. nov.

Acervuli scattered or crowded on yellowish areas, large, ½ mm., prominent, orange yellow, at maturity bursting centrally, the lacerate upturned edges of the epidermis surrounding the opening like an aecidia cup: sporules sub-cylindric, ends rounded, at first continuous, finally faintly uniseptate, about 14 × 4 μ.

On languishing leaves of *Agave* sp., no. 97. Other areas on the same leaf are blackened by some miniature fungus, probably belonging to the Pyrenomycetes.

The Mycorhiza of Tipularia unifolia*

By Julia B. Clifford

(Plate 372)

The writer of this paper undertook a study of the anatomical and physiological relations of *Tipularia* and its symbiotic fungus, for the purpose of extending information on mycorhizal adaptations, and thus affording a wider basis for the determination of the actual relation between plants associated in this manner.

The material examined consisted of a number of living specimens from South Corolina, which were grown in the greenhouse of the University of Minnesota. The plant consists of an irregular solid corm which sends out an offset in midsummer, from which is formed a daughter corm, giving rise to a single ovate leaf in the autumn which survives the winter. In the spring the leaf dies away and the corm sends up a scape 49 to 50 centimeters high, bearing a raceme of greenish flowers. The roots are few in number, fibrous, and depend from the base of the corm.

Structure of the Roots

The Stele.—The stele is tetrarch, well developed, and fairly large for the size of the root, each bundle consists chiefly of two or three large scalariform ducts and a number of spiral vessels. Alternating with the bundles are groups of twelve to twenty sclerenchymatous fibers in which the lumen is almost obliterated. The pericycle is interrupted, and its elements are quite irregular in mature organs. The endodermal cells are large, uneven in size, the lateral walls are sometimes thickened, and all are suberized.

The Cortex.—External to the stele is a region of the cortex consisting of four to six layers of short cylindrical cells, with small intercellular spaces, and thin cellulose walls. These cells contain large fungal vesicles in contact with the nuclei and those of neighboring elements may be seen to be connected by hyphal

* The work described in this paper was done in the physiological laboratory of the University of Minnesota, under the direction of Professor D. T. MacDougal of the New York Botanical Gardens, who also revised the manuscript.

threads. In many instances the vesicles almost fill the cells They stain a yellowish brown with Bismark brown and alcohol In the older portions of the root these vesicles are seen to disintegrate and free their contents in the cortex, as has been described by MacDougal in *Corallorhiza*†

The nuclei of the cells inhabited by the fungus show a varied behavior. In some instances they are double the normal size, very granular, and hyperchromatic. The shape in such instances varies from spherical to oblong ovoid. In roots examined early in May the nuclei of the infected cells were irregular in outline, diminished in size, and in some instances had fragmented into two or three segments.

External to the region just described is a second, consisting of two layers of long cylindrical cells, with no intercellular spaces, and thickened at the angles. These cells contain active hyphae which form more or less dense convolutions at random, but which do not appear to influence the nucleus of the cell inhabited, as they are fairly normal in size and structure.

The Sheath.—The outer layer of the cortex consists of two kinds of cells; a long cylindrical form, and a short cylindrical form of smaller diameter. The longer cells are placed with their greater axes parallel to that of the root, and they alternate with the shorter ones which have their longest diameter radial. Any row of cells in this layer consists of the two kinds of cells placed alternately, so that each long cell is separated from the end of the one above it by a short one. The diameter of the short ones is less than that of the long ones, and as a consequence, the edges of the long ones may be prolonged to meet at the sides of the short ones, a fact that may be seen in tangential sections only.

The outer and inner walls of the smaller cells of this layer are noticeably thinner than the later ones and this device allows the ready passage of the hyphae, which crowd through these passage cells so densely as to almost fill the cavities. (Pl. 372. *f.* 4.)

Epidermal Tissue.—External to the sheath is a tissue consisting of four or five layers of thin-walled cells, rich in protoplasm, with no intercellular spaces. This layer is continuous over the apex of the root, on which no cap can be distinguished. It is suggested

† Symbiosis and Saprophytism, Bull. Torr. Bot. Club, Oct., 1899.

that this may be a true many-layered epidermis, developed for the especial needs of a mycorhizal organ, similar to that described by Groom in *Thismia* (Annals of Botany, 1895). The outer wall of the external layer is extended in the form of root-hairs which are persistent, and which exhibit great diversity of shapes. Some of these organs are branched, while the apices of others are converted into hollow disks, or into the form of the pileus of a mushroom. These hairs are traversed by hyphae which pass through their lateral walls into the humous soil.

The cells of the epidermal tissue contain hyphae which pass towards the apex of the root in nearly straight lines. The hyphae give off short lateral branches which are enlarged, and are of the form of the sporophores of some of the moulds, though never seen to develop spores. These organs are cut off from the main hyphae by septae, and are sometimes to be seen separated from the hyphae, and may possibly serve as reproductive bodies. The hyphae are septate throughout all of the regions mentioned.

The hyphae which traverse the root-hairs sometimes form convolutions within them, and nearly all of the hairs thus inhabited show distortions as previously described.

In addition to the symbiotic fungus, the smaller hyphae of a second organism, probably parasitic may be seen in the roots of some specimens.

SUMMARY

The principal features of interest in the mycorhiza of *Tipularia* consist in the lack of the root cap, the development of a many-layered epidermal tissue, which serves the immediate purpose of affording a habitat for the vegetative mycelium of the symbiotic fungus: the formation of a special sheath from the external layer of the cortex, certain cells of which are converted into passage-cells, through which the internal hyphae find an easy passage into the medio-cortex with its rich content of carbohydrates.

The general organization of the fungus, and its relation to the seed plant is similar to that described by MacDougal in *Corallorhiza* and other mycorhizal forms.* The hyphae in the epidermal

* Symbiosis and Saprophytism, Bull. Torr. Bot. Club, Oct., 1899.

tissue constitute the vegetative mycelium, which sometimes forms branches which may be reproductive in their primary purpose. Branches are given off which traverse the root-hairs and penetrate the soil, constituting the absorbing organ of the mycorhiza, and which serve to bring the humous products within the root. Branches are given off which penetrate the cortex through the passage cells, forming vesicles which serve as organs of interchange. Starches and other carbohydrates are taken from the higher plant, and proteids are formed from these and the humous products brought in from the soil, which are finally liberated by the disintegration of the vesicles. The seed plant affords a habitat also to the fungus, so that a fairly well balanced symbiosis is the result.

Explanation of Plate 372

All drawings were made from a Bausch and Lomb one-fifth inch apochromatic objective, and a No. 4 compensating ocular. Magnification 159 except in figure.

FIG. 1. Cross section of stele. *x*, *x*, *x*, *x*, *x*, scalariform ducts. *s*, spiral vessels.

FIGS. 2 and 3. Root-hairs, showing form and traversing hyphae.

FIG. 4. Tangential view of outer cortical sheath, showing the long cylindrical sheath cells, alternating with the short passage-cells.

FIG. 5. Longitudinal section of cortex and epidermis. *e*, outer epidermal cells with root-hairs. *s*, sheath. *o*, region containing vegetative mycelium of fungus. *m*, medio-cortex. *h*, disintegrating vesicles. *n*, nucleus.

Proceedings of the Club

TUESDAY EVENING, OCTOBER 10, 1899

Vice-President Rusby in the chair; 33 persons present.

The following new members were elected: Miss Mary B. Pitman, 304 E. 21st St.; Mrs. Francis B. Arnold, 101 W. 78th St.; Mrs. E. E. Olcott, 38 W. 39th St.; Miss Lucy McIntyre, 303 W. 74th St.; Dr. A. Henri Hart, 73 Lexington Ave.; Mr. S. Whitney Dunscomb, Jr., 132 Nassau St.: nominated by Dr. H. H. Rusby as Chairman of Committee on Membership. Mr. Gustave Heinen, 142 Second Ave.; Miss Rosalie Rosenburg, 128 E. 70th St.: nominated by the Secretary. Miss Annie D'Zan, 63 Stuyvesant Ave., Brooklyn: nominated by the Treasurer.

In response to an invitation from Dr. MacDougal, secretary of section G of the A. A. A. S. a committee was appointed to prepare a memorial program in honor of Dr. Torrey, to be given at the June meeting of the Association in New York; this committee to consist of the President, the Vice-President, the Secretary and two other members whom they shall appoint.

Dr. Britton called attention to the expected opening of the Museum at the Botanical Garden in December, and suggested that it might be appropriate that the first scientific meeting to be held there be that of the Torrey Club, this Club having made the first movement toward starting the Botanical Garden.

The remainder of the evening was devoted to reports from excursions and from summer observations by members.

Dr. Rusby, as guide to nine excursions in the spring, reported an average attendance of 31.

At Floral Park, L. I., May 20th, the club enjoyed the fine botanical library of Mr. C. L. Allen, and the method of cultivating seedling tulips shown by Mr. E. S. Miller.

June 3d the club was very kindly entertained at Fort Lee by Mr. and Mrs. Wm. O. Allison.

Miss Sanial, from the Committee on Field Excursions, followed, making a report embodying lists of species observed during the excursions from June onward.

October 7th the Club went to Plainfield, N. J. The guide, Miss Noll, of Plainfield, invites the Club there in the coming spring, and calls attention to the occurrence of *Mertensia* at the Raritan near that place.

Mrs. Britton reported on a trip June 27, to Closter, N. J., for the purpose of photographing the house in which Austin lived. He is buried at Orangeburg, N. Y., six miles north.

Professor Underwood reported on the Decoration Day excursion to Tullytown, Pa.; about 20 persons from Philadelphia and 12 from New York present. *Isoetes riparia*, a tidal plant, occurred along streams tributary to the Delaware.

Dr. Britton reported further of this trip regarding a patch of pine-barren species explored there, among which grew a *Senecio* resembling *S. Oakesianus* of the Adirondacks but probably different.

Dr. Britton reported also on the 4th of July excursion to the Delaware River at Bull's Island, another *Isoetes*, *I. Dodgei*, occuring there.

Professor T. C. Porter reported at the latter place the occurrence of *Equisetum littorale*, *Onosmodium Virginianum*, etc.

Both of these excursions were contributary to Dr. Fretz' revision of Moyer's catalogue of the Bucks Co. flora soon to be issued. It is now being worked out with attention to details of distribution, ecology and modern taxonomic views.

Discussion regarding various gentians followed.

Mr. Van Brunt reported seeing a single stem of *Gentiana crinita* bearing 59 flowers, all the upper, certainly 20, in full bloom. Placing the plants, after clipping, in the dark over night and leaving until 9 or 10 A. M., they expanded beautifully on exposure to the light.

Rev. L. T. Chamberlain reported 96 buds and blossoms on a single stem of *Gentiana crinita* in Mass., at West Brookfield. White blossoms came out in six weeks after it, the stem having bloomed in his study 42 days. Mr. Chamberlain also reported that Dr. Isaac Lea, of Philadelphia, had told him of finding a stem of *Gentiana crinita* with 150 blossoms.

Professor Porter called attention to white flowers of *G. Andrewsii;* it is this he thinks which was described as *G. alba.*

He spoke of the habit of *Gentiana quinqueflora* to produce a

great variety of size in the same soil, with little dwarfs with one flower at one inch high.

Professor Porter spoke of *G. flavida* as recently found in Bucks Co.

Dr. Rusby referred to a successful experiment in scattering the seeds of the fringed gentian upon the snow, resulting in a profusion of young seedlings.

Mr. Henshaw paid a tribute to the beauty of the alpine gentians of the Old World, and to the cultivation of seedling tulips by his father, waiting till the seventh year for them to "break," growing only late-flowering tulips. Mr. Henshaw said he had no theory of the cause but had never known one to fail to "break," and knows of no other plant of similar habit.

Rev. L. T. Chamberlain spoke of a walk near Fabyan's in the White Mountains with the whole covering of the earth composed of *Cypripedium acaule*, seemingly a hundred thousand plants.

EDWARD S. BURGESS,
Secretary.

Index to recent Literature relating to American Botany

The Cambridge Botanical Supply Company will discontinue the publication of the Card Index of Literature relating to American Botany, January 1st, and the Committee of Section G of the A. A. A. S. is seeking to continue it under other arrangements. The present subscription price of $5 per year was made when only about 500 cards were issued and is inadequate to support the enterprise with the number of titles increased to upwards of 800.

It has been decided to make the rate one cent per card. The number of subscribers will govern the number of sets printed, and the matter will not be electrotyped. Intending subscribers should notify the editor of the Bulletin of the Torrey Botanical Club at once.

Ames, O. An easy Method of propagating *Drosera filiformis*. Rhodora, **1**: 172. *pl. 8.* S. 1899.

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G. Evansi, sp. nov.

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Collins, F. S. Notes on Algae.—I. Rhodora, 1: 9–11. Ja. 1899.
Rivularia compacta, sp. nov.

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Coulter, J. M. & Rose, J. N. *Hesperogenia*, a new Genus of Umbelliferae from Mount Rainier. Contr. U. S. Nat. Herb. **5**: 203. *pl. 27*. 31 O. 1899.
H. Stricklandi, sp. nov.

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Dixon, H. N. *Plagiothecium Müllerianum* Schimp. and the allied Species. Rev. Bryol. **26**: 17–21. 1899.

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A. ambigens and *A. Brainerdii*, new species.

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Ganong, W. F. Polyembryony in *Opuntia vulgaris*. Rhodora, **1**: 127, 128. Jl. 1899.

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[This Index is reprinted each month by the Cambridge Botanical Supply Company in card catalogue form.]

Errata

P. 235, fourteenth line. For *five*, read *fine*.

P. 350. No. VIII. was accidentally omitted in numbering this series of papers.

P. 356, twenty-first line. For *C. squarrosa*, read *G. squarrosa*.

P. 444. In "explanation of Plate 366," Fig. 17. For *spores*, × *315*, read *spores*, × *230*.

P. 545, first line. For *Symphoricarpus*, read *Symphoricarpos*.

P. 583, thirteenth line (in key). For *Wootoni*, read *Wootonii*.

P. 587, thirteenth line. For *Wootoni*, read *Wootonii*.

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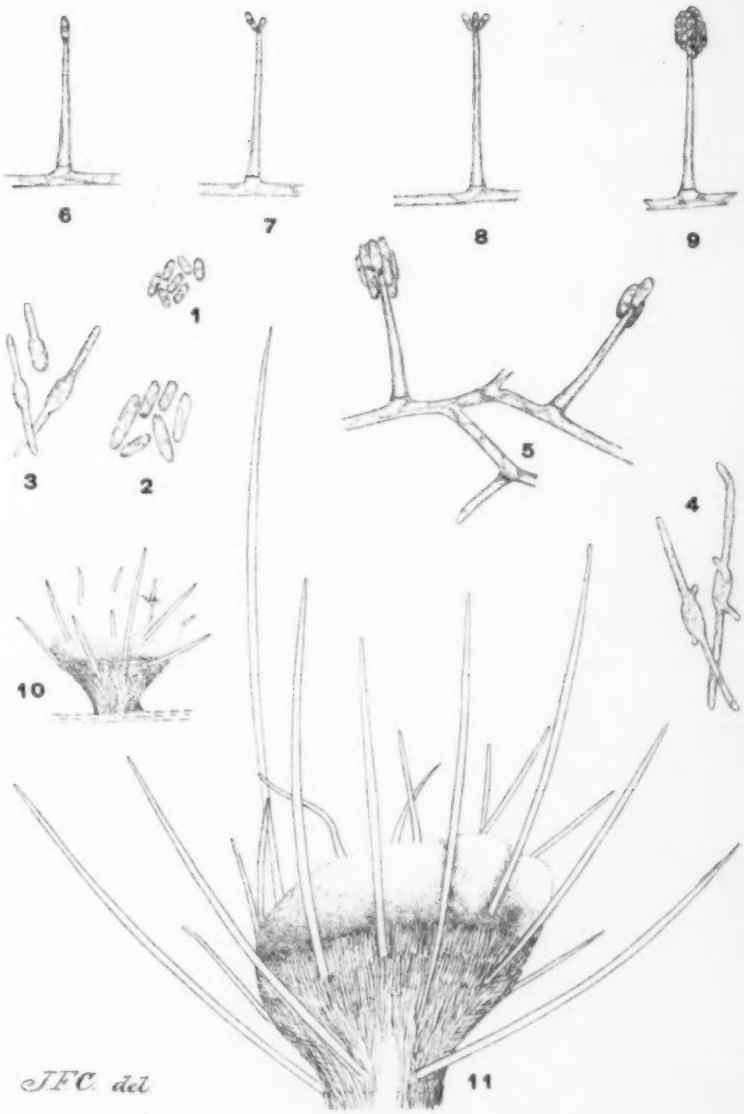

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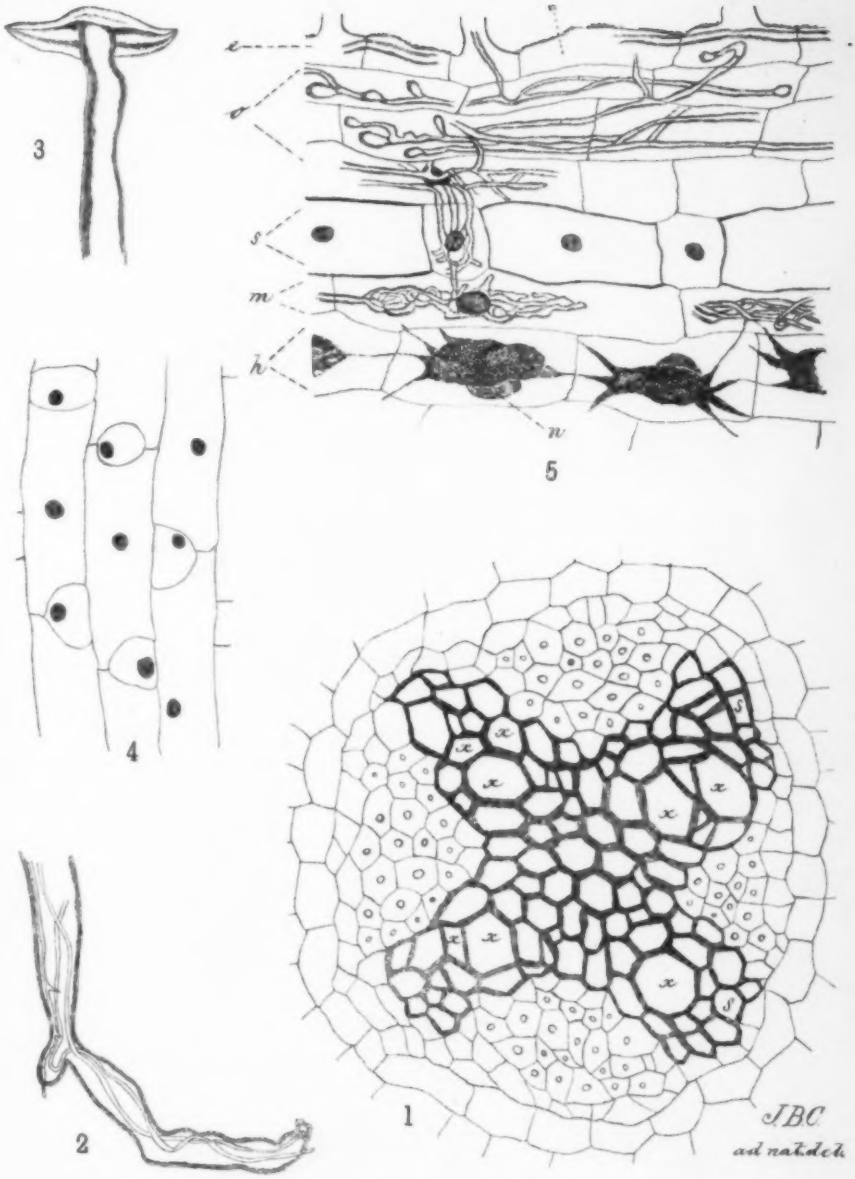

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